dcm THE LEARNING EXPERTS

Lean Six Sigma

Lean Thinking

- Theory
- Maths & Stats
- Principles
- Mindset
- Tools & Techniques
- DMAIC Project Management
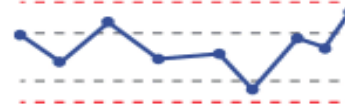- Structure
- Culture
- Philosophy

Guinness Brewery — 1900

Shewhart Introduces SPC — 1930
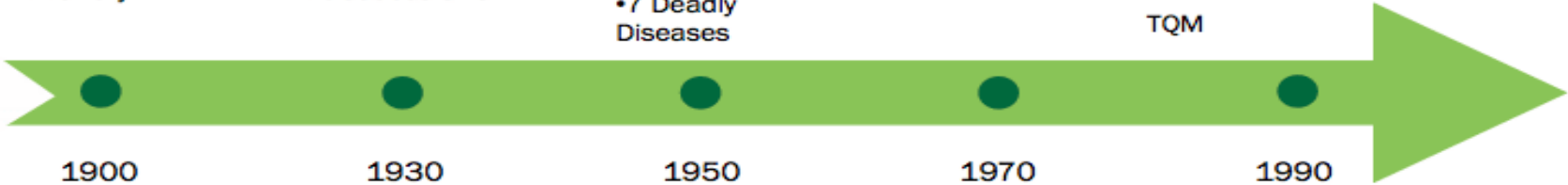
Deming
- 14 Points
- 7 Deadly Diseases
— 1950

SPC — 1970

TQM

Motorola Introduces Six Sigma — 1990
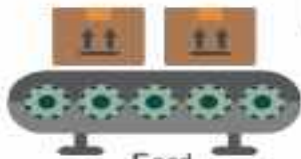
Ford Assembly Line — 1900
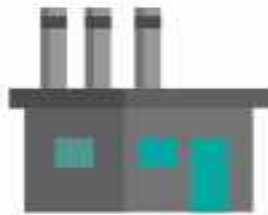
Gilbreth, Inc.
- Management Theory
- Industrial Engineering
— 1930

Toyota Production System — 1950

Just In Time — 1970

Lean Manufacturing — 1990

What is **Lean Six Sigma ?**

LEAN
Focuses on waste reduction by streamlining a process.

+

SIX SIGMA
Focuses on preventing defects through problem solving.

=

LEAN SIX SIGMA
Lean strengthens Six Sigma: Problem solving + improving processes delivers greater results.

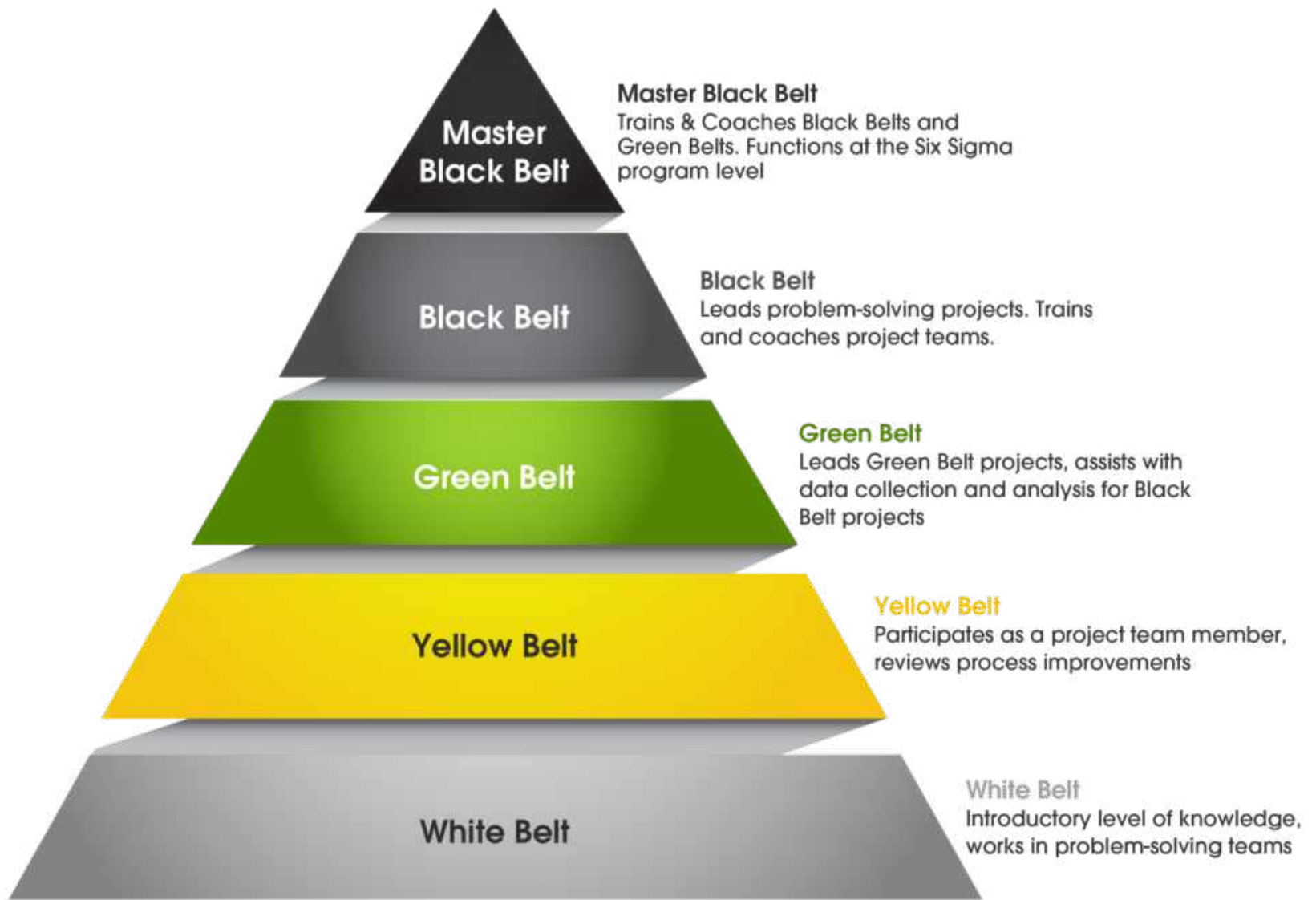| Reduce Waste		Reduce Variation		
Agility		Accuracy		Lean 6 Sigma is the combination of Lean & Six Sigma principles, forming a methodology for systematic improvement
Concise	+	Consistent	=	
Efficient		Effective		
PDCA		DMAIC		

Roles within Lean 6 Sigma

Master Black Belt
Trains & Coaches Black Belts and Green Belts. Functions at the Six Sigma program level

Black Belt
Leads problem-solving projects. Trains and coaches project teams.

Green Belt
Leads Green Belt projects, assists with data collection and analysis for Black Belt projects

Yellow Belt
Participates as a project team member, reviews process improvements

White Belt
Introductory level of knowledge, works in problem-solving teams

Executives: Provide overall alignment

- Establish strategic focus of the Six Sigma program
- Within the context of the organization
- Culture and vision

Champions: Translate the company's Vision / Mission   Goals

- Create organisation wide deployment plan
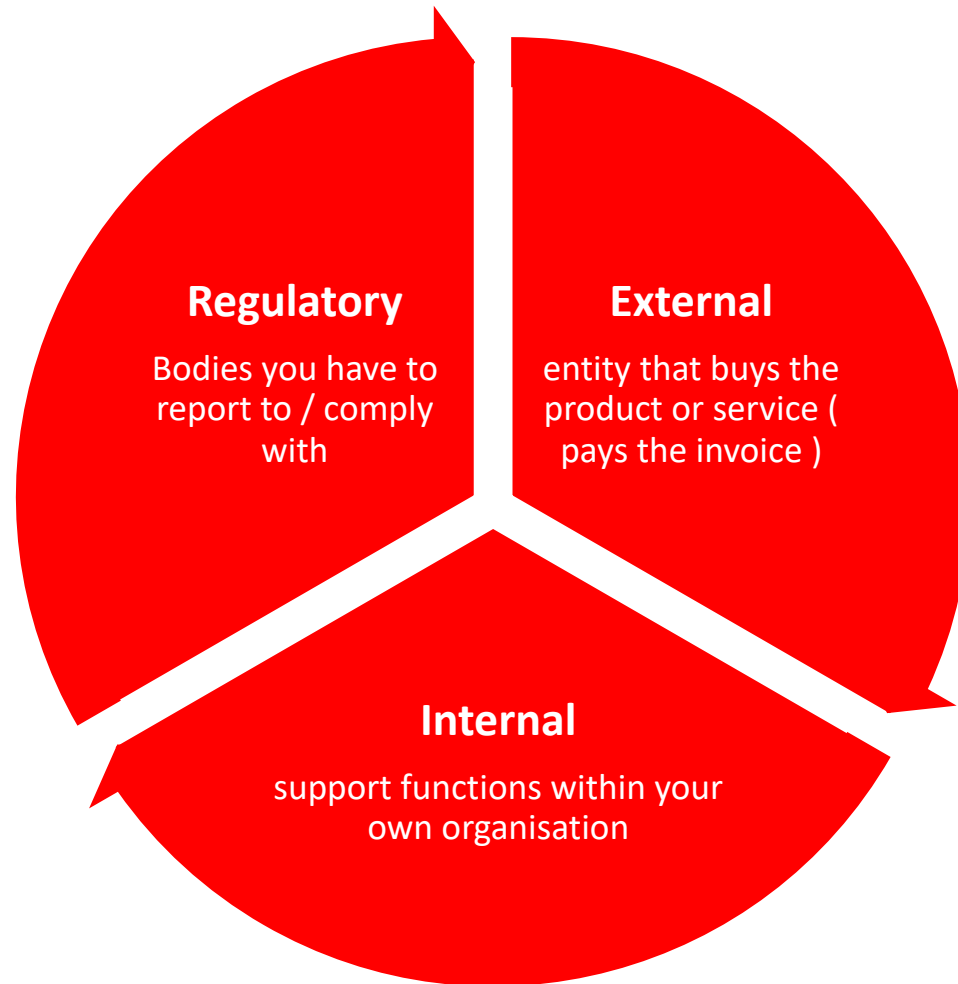- Identify and provide resources
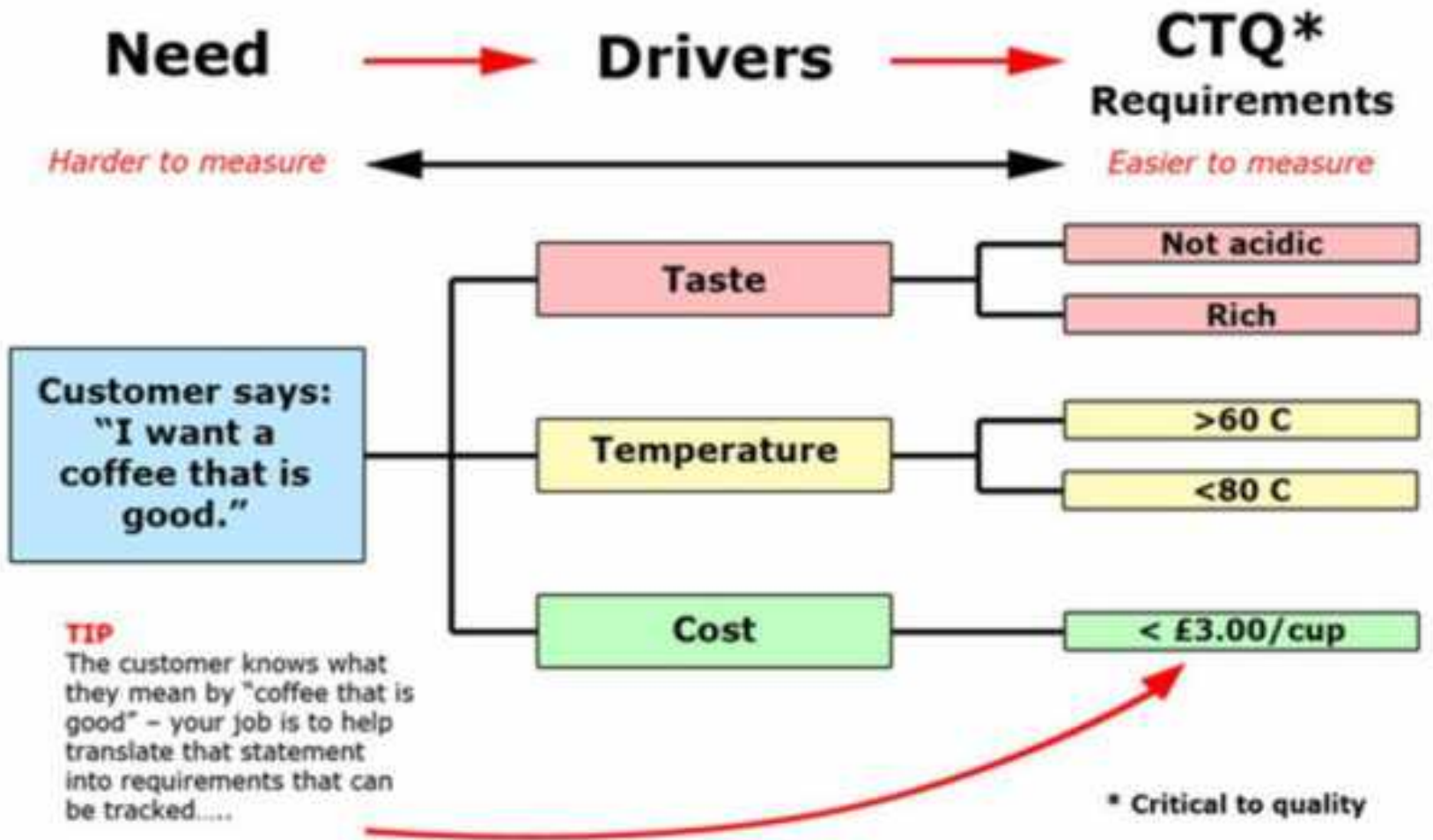- Clout and influence to remove barriers

Lean Basics

Benefits of Lean

Increased:
- Effectiveness
- Competitiveness
- Throughput/productivity
- Customer satisfaction
- Return business
- Job satisfaction
- Agility/response to customer demand

Reduced:
- Cost to provide a product/service
- Time to market
- Cycle times
- Customer complaints
- Stress for all stakeholders

05.
PURSUIT PERFECTION

04.
ESTABLISH PULL

LEAN PRINCIPLES

01.
DEFINE VALUE

03.
CREATE FLOW

02.
MAP VALUE STREAM

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Regulatory

Bodies you have to report to / comply with

External

entity that buys the product or service (pays the invoice)

Internal

support functions within your own organisation

Kano Model

Lead time

Trigger

REPEAT

$

VA

NNVA

NVA

TRANSPORT	INVENTORY	MOTION	WAITING
Unnecessarily moving things, equipment, parts, tools and materials from one location to another.	Making more than customer demand, building up unnecessary stocks.	Unnecessary movement; people walking to get things which should be located closer to the point-of-use.	Delays between operations because parts are missing. Stopped work: waiting for parts, machines, or people.

| OVER PRODUCTION	OVER PROCESSING	DEFECTS	SKILLS
Making too much or too many. Completing a task before it is needed. Making products that the customer hasn't ordered.	Duplicate or redundant operations, performing wasteful steps that are not required. Often because "we always do it this way."	Failing to produce a quality part the first time generating rework or scrap. Not delivering the product or service "right the first time."	Failing to use skills and capabilities of the workforce. Not listening to people, using their knowledge or learning from past mistakes/issues.
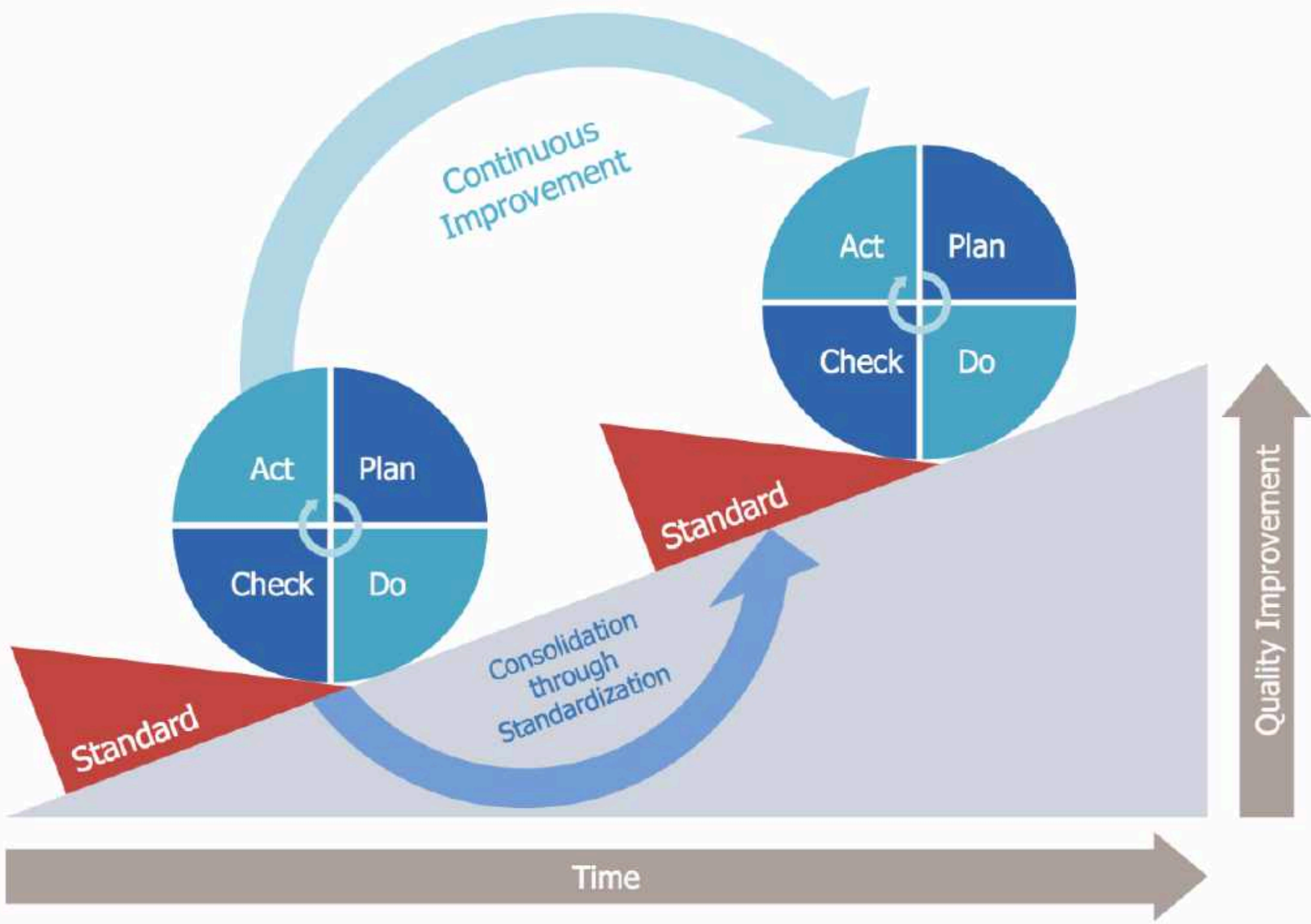
Six Sigma Basics

$$Y = f(Xi)$$

To control Output Y

All critical inputs must be identified
& Controlled

Only then will we have "control" of the
Variation in and performance of a process

Six Sigma
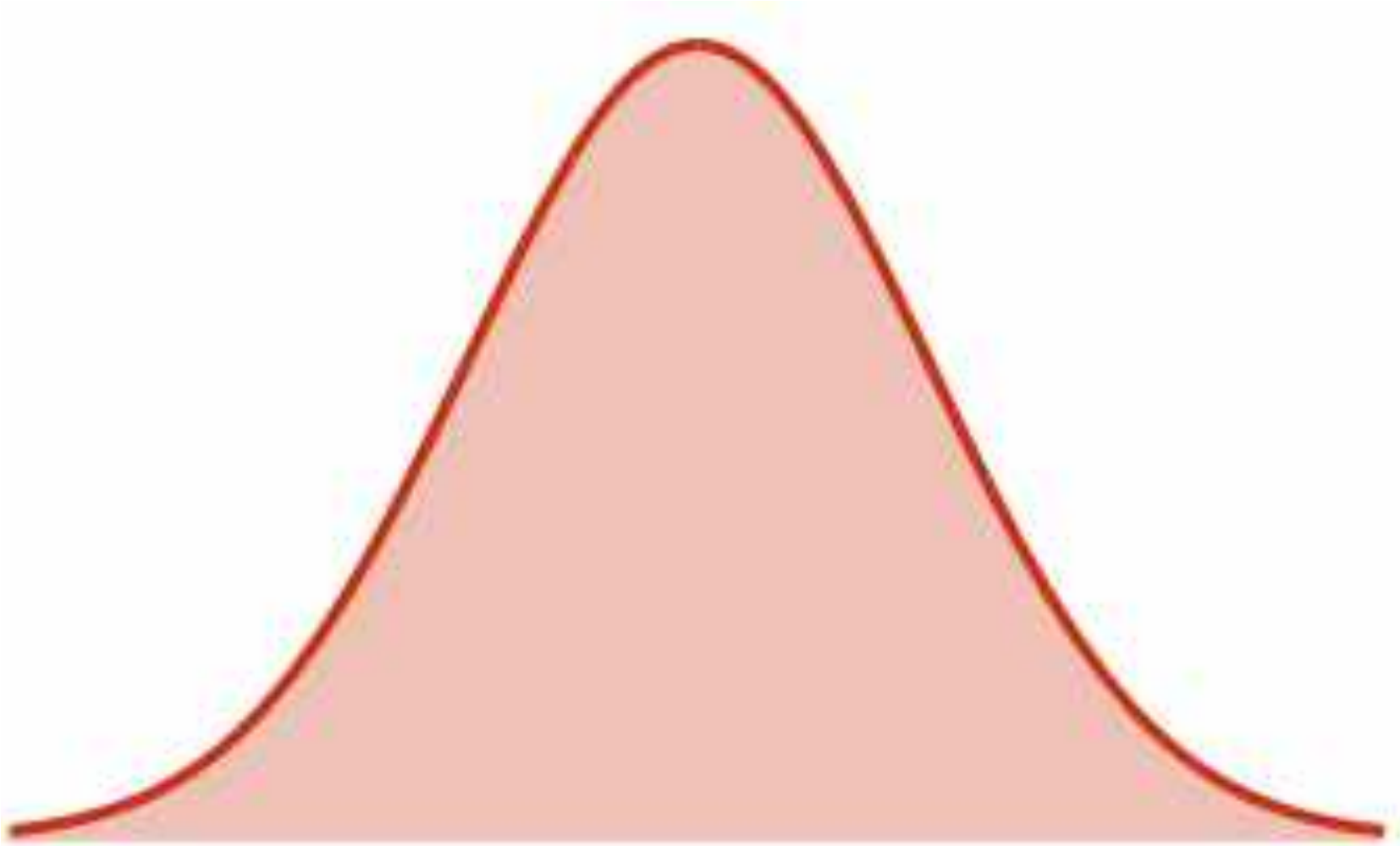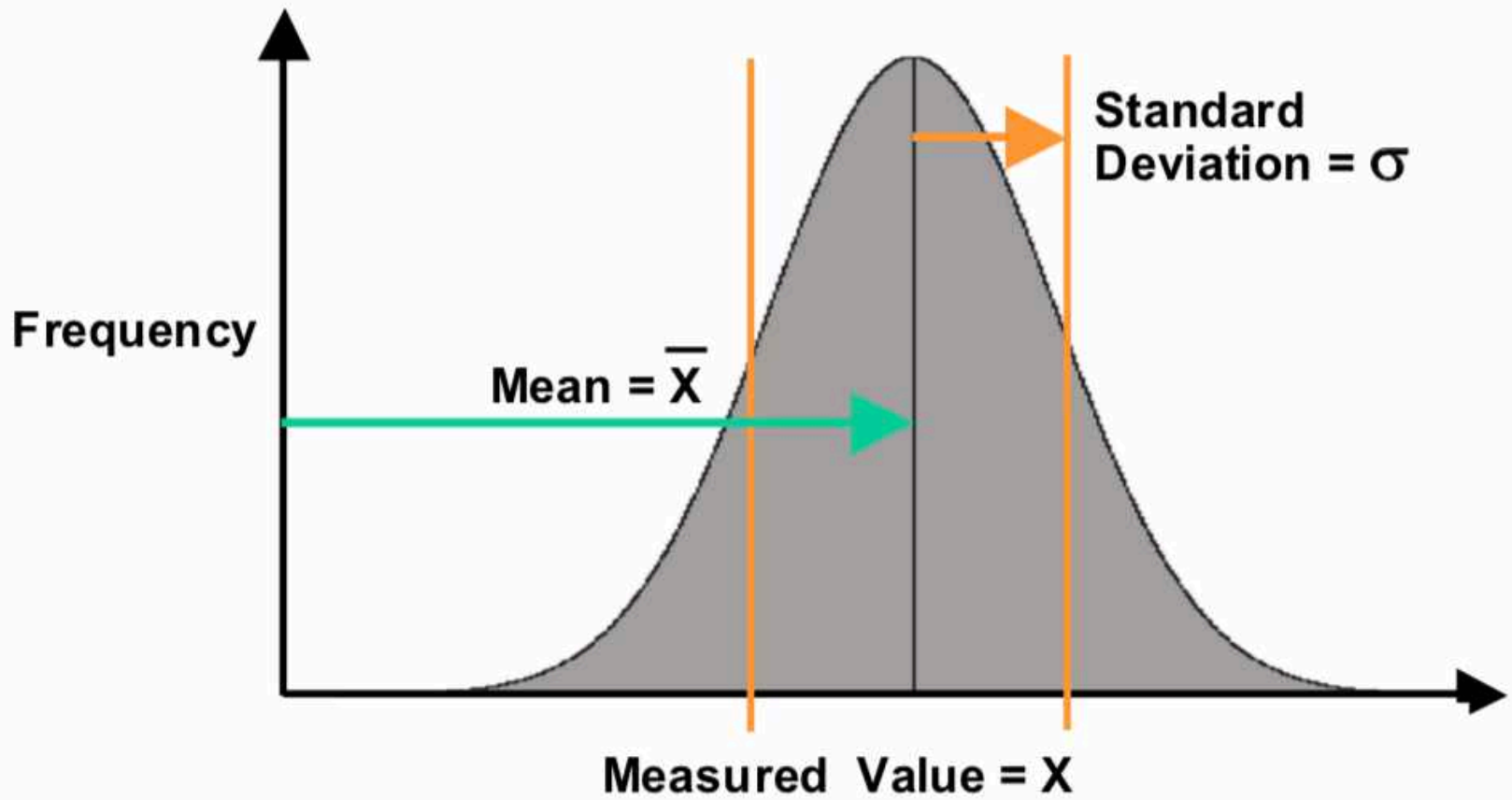
Standard Deviation

1, 2, 3, 4, 5, 6, 7

-3, -2, -1, 0, +1, +2, +3

Standard Deviation

Formula

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

σ = population standard deviation

N = the size of the population

x_i = each value from the population

μ = the population mean

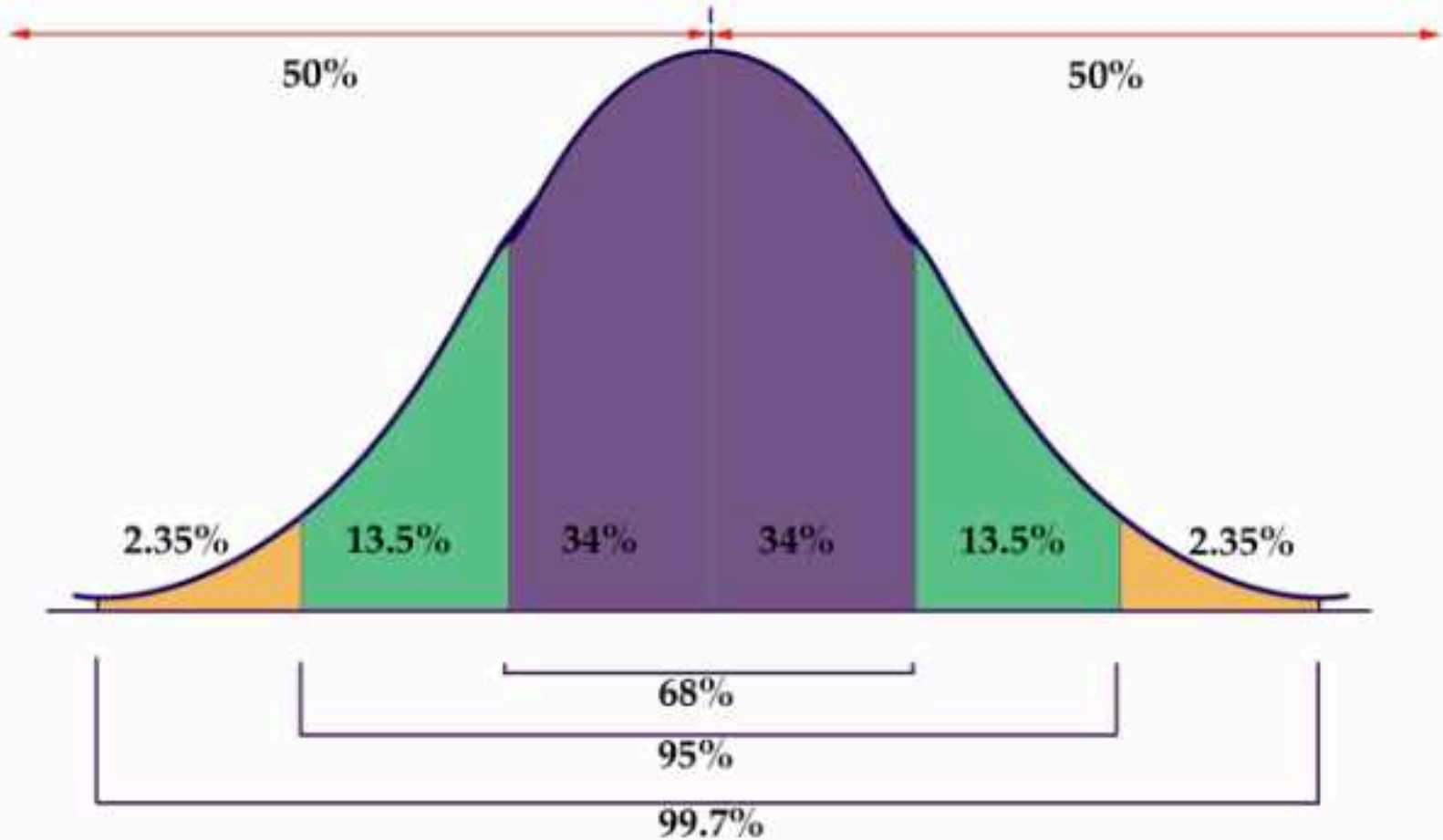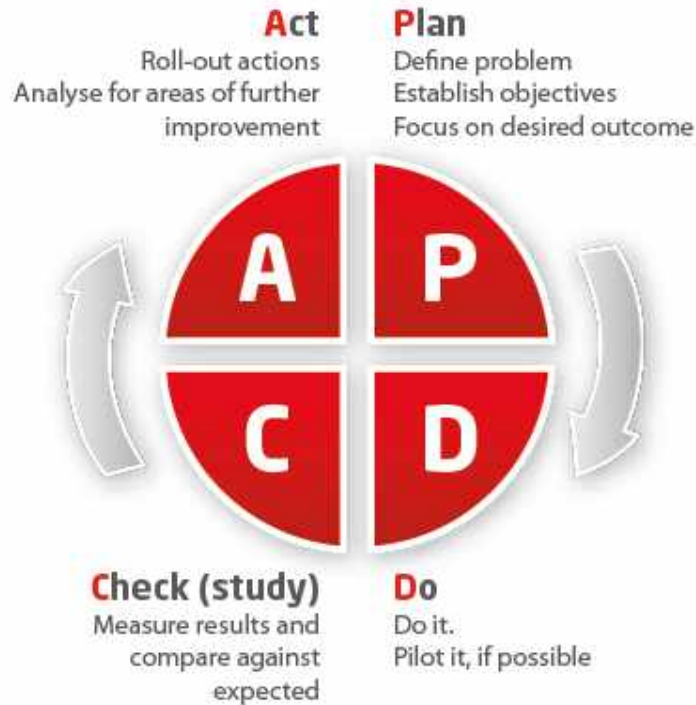# Six Sigma

Empirical Rule

Six Sigma

And that number is 99.9997%

LEAN & Six Sigma

PDCA Cycle

Act
Roll-out actions
Analyse for areas of further
improvement

Plan
Define problem
Establish objectives
Focus on desired outcome

A	P
C	D

Check (study)
Measure results and
compare against
expected

Do
Do it.
Pilot it, if possible

DMAIC

	Description	Tools
Define	Define the problem and project elements: goals, form the team, set improvement target	Project Charter, Loss Analysis (OEE & Six Loss), Stakeholder Analysis/ SIPOC, Process mapping
Measure	Determine method of measurement and gather current baseline data	Value Stream Mapping, Check sheets, LineView Data, FMEA, Pareto charts
Analyse	Analyse the data to identify root cause(s)	5 Whys, Fishbone, Cause & Effects matrix, Scatter plots, Hypothesis testing
Improve	Generate improvement ideas to address root cause(s) & implement	Initiative Prioritisation (Bubble Chart), Brainstorming, Ease & Effect
Control	Confirm goals reached and implement actions to measure and sustain	One-Point Lessons, Control charts, SIC reviews, Milestone Planning

dcm THE LEARNING EXPERTS

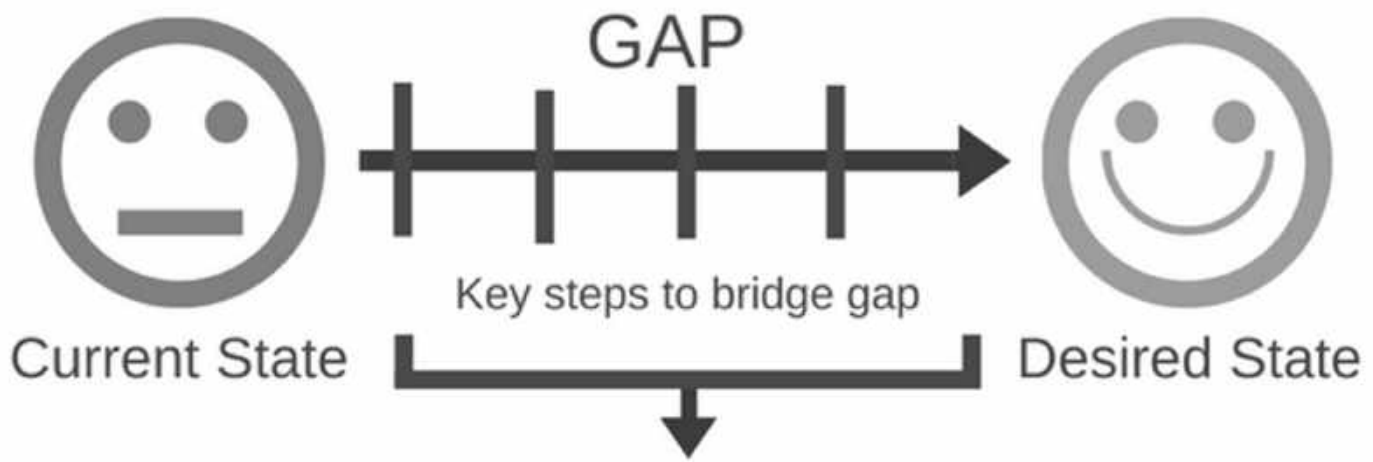# DMAIC Basics

Project Methodologies

PMI's PMBOK

Prince 2

Agile & Scrum

Lean / DMAIC

DMADV / DFSS

GAP

Key steps to bridge gap

Current State

Desired State

dcm THE LEARNING EXPERTS
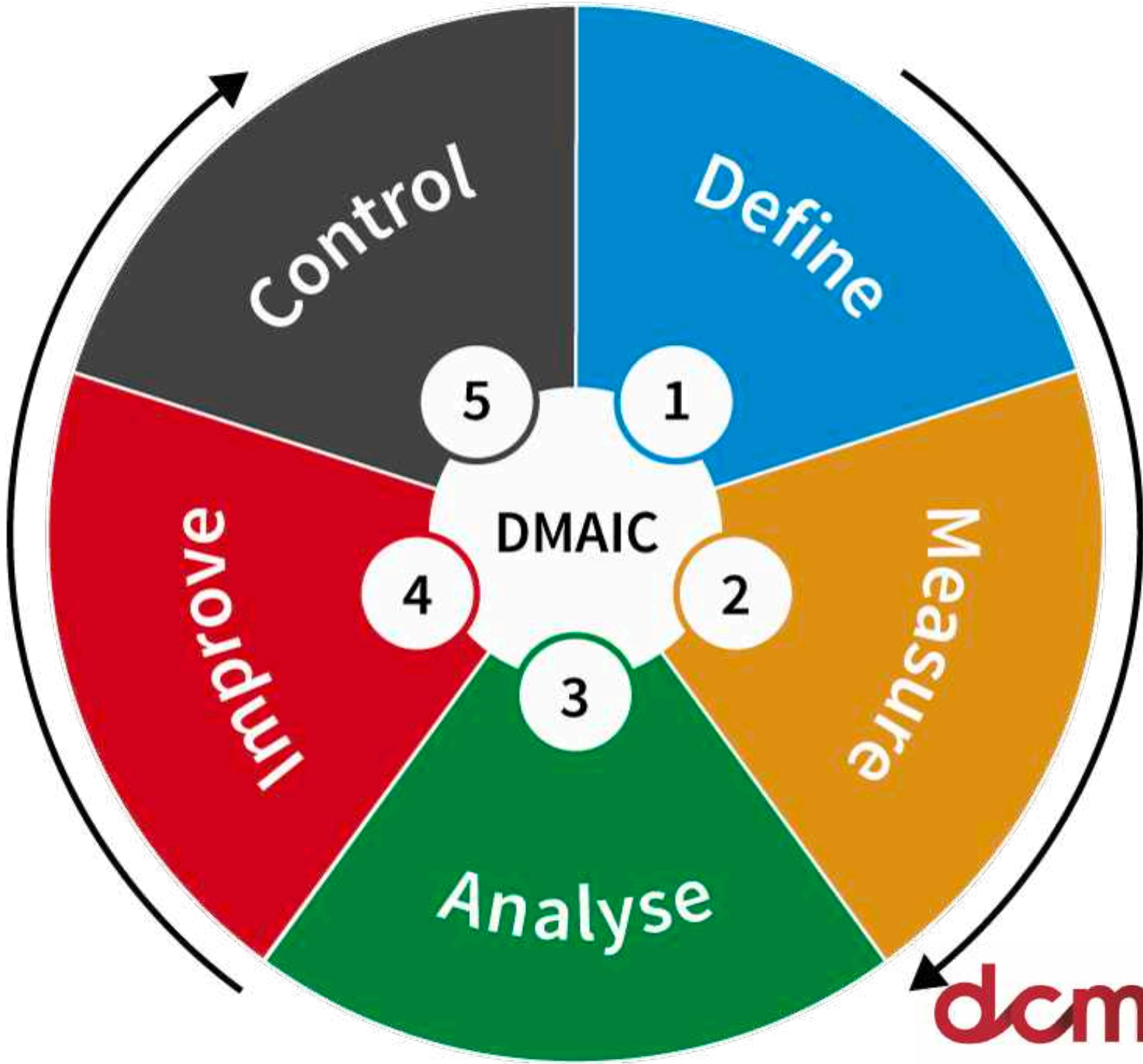
DEFINE
Define the problem and the ideal in terms of the target to achieve.

MEASURE
Collect relevant data about the process and the problem.

ANALYSE
Analyse the process to identify the cause-effect relationship between inputs and outputs. Identify the vital few root causes.

IMPROVE
Determine the optimum values for key contributing process inputs. Implement solutions to eliminate the root causes.

CONTROL
Establish standards and controls to sustain improvements in the long run.

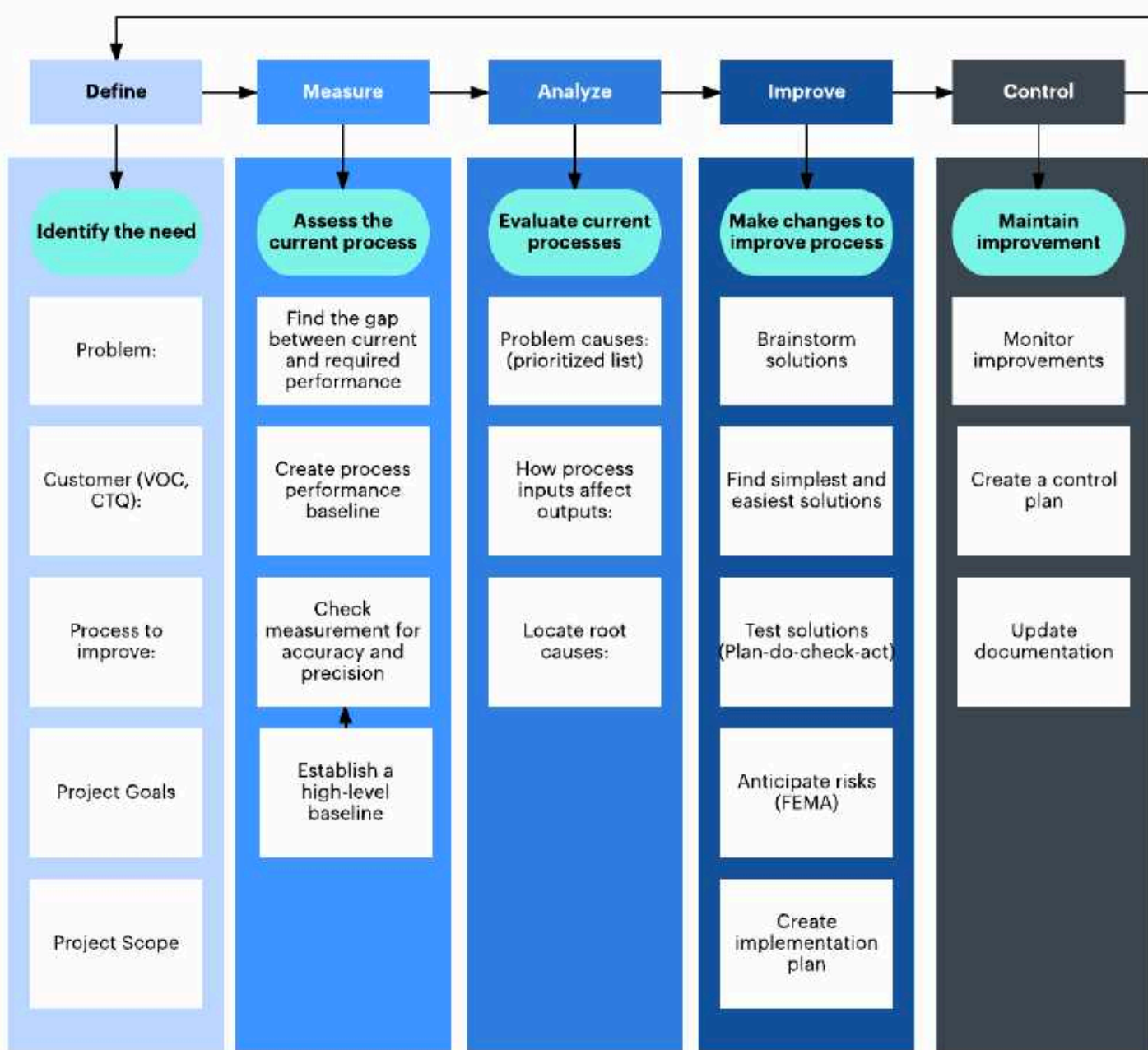| Define	Measure	Analyze	Improve	Control
Identify the need	**Assess the current process**	**Evaluate current processes**	**Make changes to improve process**	**Maintain improvement**
Problem:	Find the gap between current and required performance	Problem causes: (prioritized list)	Brainstorm solutions	Monitor improvements
Customer (VOC, CTQ):	Create process performance baseline	How process inputs affect outputs:	Find simplest and easiest solutions	Create a control plan
Process to improve:	Check measurement for accuracy and precision	Locate root causes:	Test solutions (Plan-do-check-act)	Update documentation
Project Goals	Establish a high-level baseline		Anticipate risks (FEMA)	
Project Scope			Create implementation plan	

Project Selection

- Project Selection

1. Must align to strategy of the business

2. Must bring potential benefits

3. Must have a clear sponsor / champion

4. Timebound   (> 5Mins < Infinity) 1 to 6M

Potential Projects

S STRENGTHS	**W** WEAKNESSES	**O** OPPORTUNITIES	**T** THREATS
• Things your company does well	• Things your company lacks	• Underserved markets for specific products	• Emerging competitors
• Qualities that separate you from your competitors	• Things your competitors do better than you	• Few competitors in your area	• Changing regulatory environment
• Internal resources such as skilled, knowledgeable staff	• Resource limitations	• Emerging need for your products or services	• Negative press/ media coverage
• Tangible assets such as intellectual property, capital, proprietary technologies etc.	• Unclear unique selling proposition	• Press/media coverage of your company	• Changing customer attitudes toward your company

Potential Projects

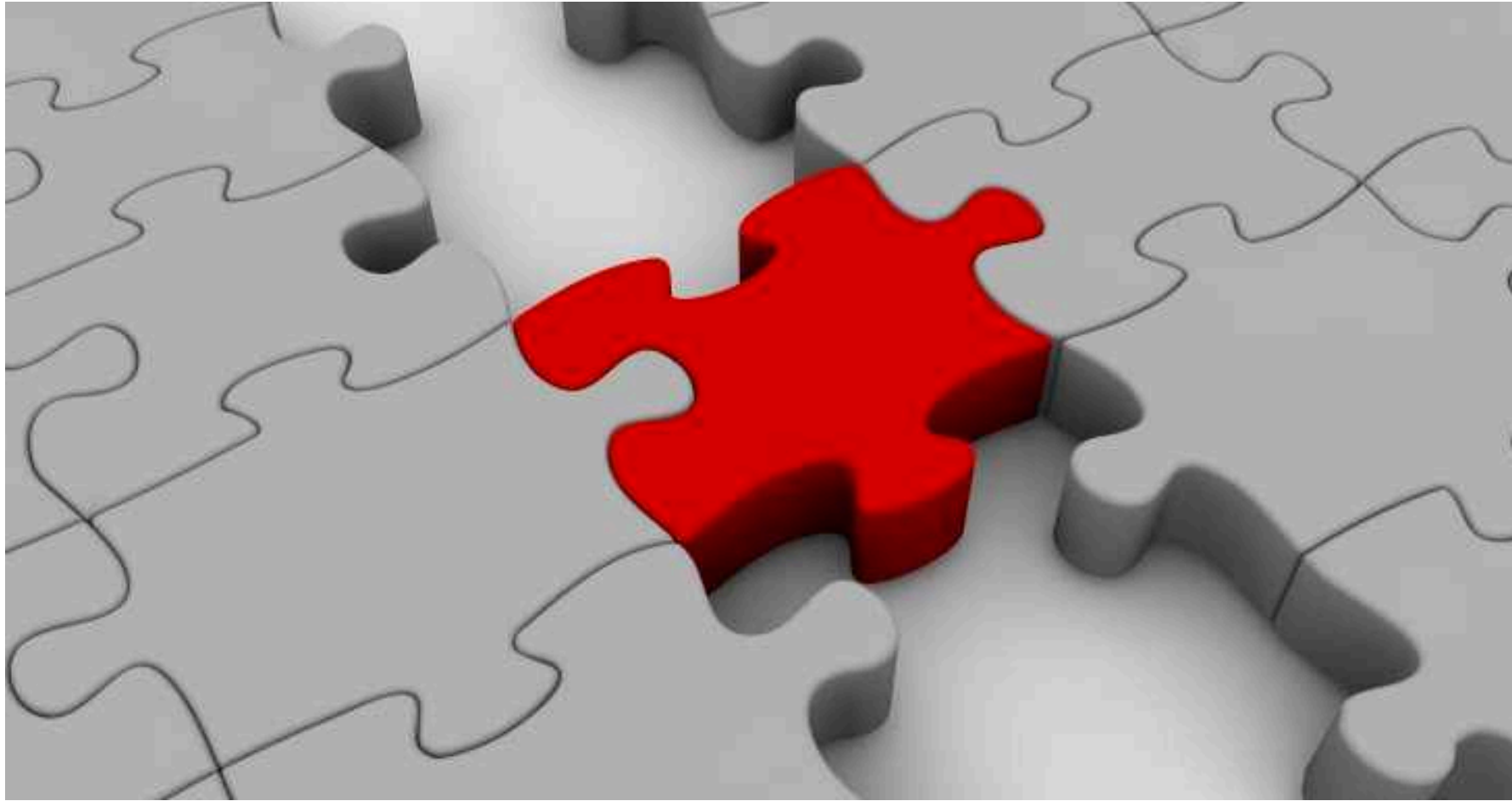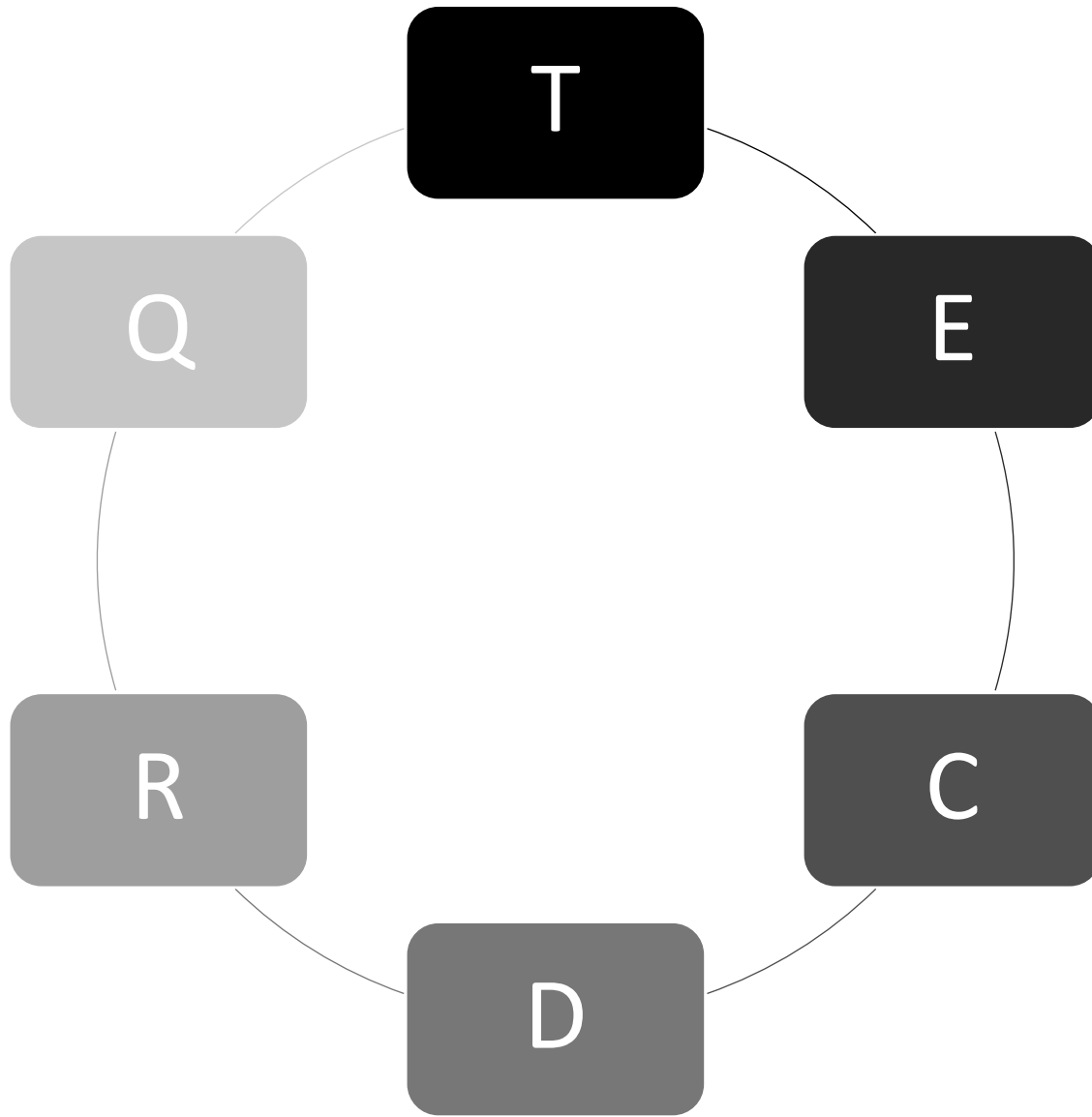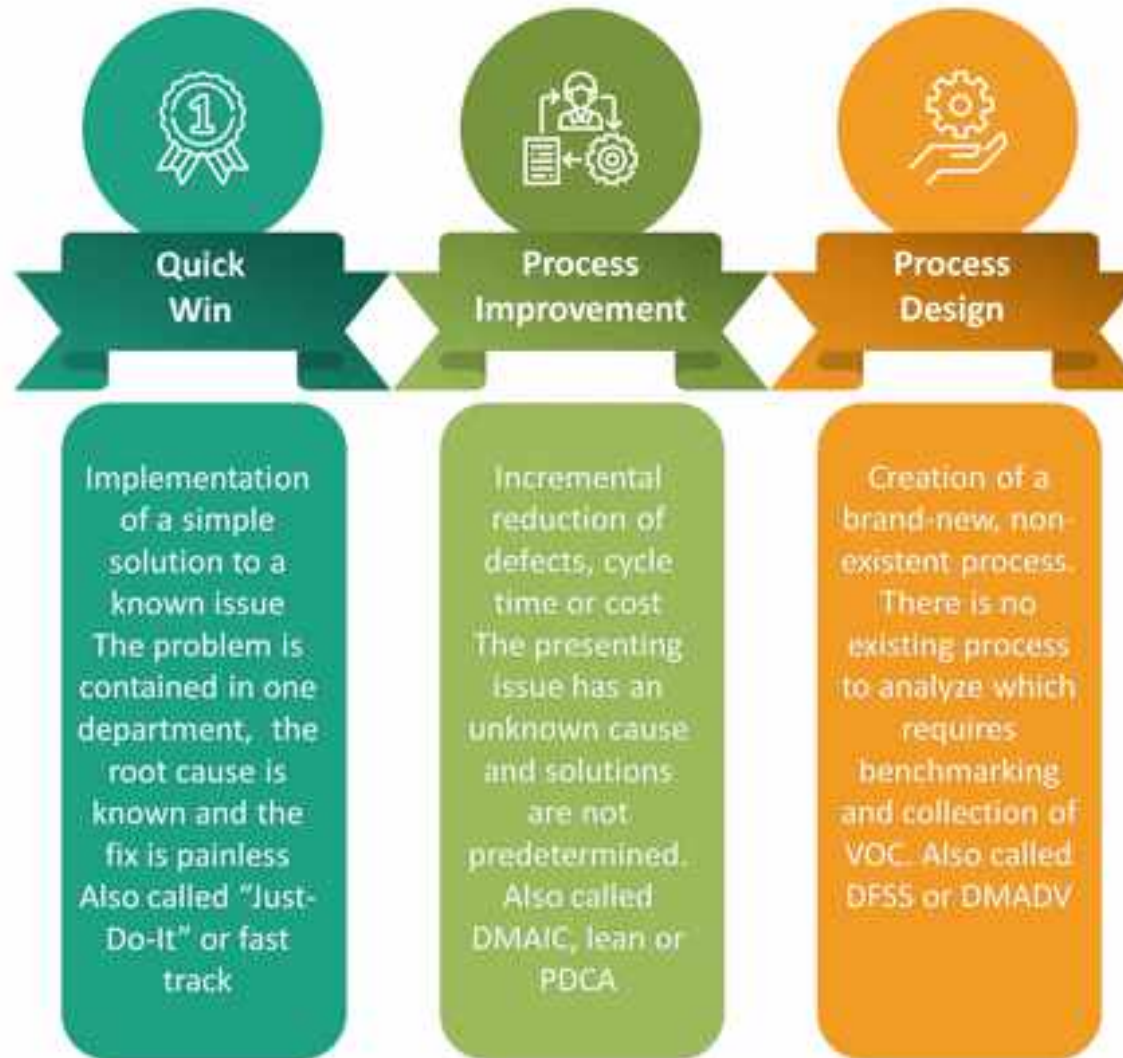| P	E	S	T	E	L
- Government policy - Political stability - Corruption - Foreign trade policy - Tax policy - Labour law - Trade restrictions	- Economic growth - Exchange rates - Interest rates - Inflation rates - Disposable income - Unemployment rates	- Population growth rate - Age distribution - Career attitudes - Safety emphasis - Health consciousness - Lifestyle attitudes - Cultural barriers	- Technology incentives - Level of innovation - Automation - R&D activity - Technological change - Technological awareness	- Weather - Climate - Environmental policies - Climate change - Pressures from NGO's	- Discrimination laws - Antitrust laws - Employment laws - Consumer protection laws - Copyright and patent laws - Health and safety laws

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Potential Projects

Quick Win	Process Improvement	Process Design
Implementation of a simple solution to a known issue. The problem is contained in one department, the root cause is known and the fix is painless. Also called "Just-Do-It" or fast track	Incremental reduction of defects, cycle time or cost. The presenting issue has an unknown cause and solutions are not predetermined. Also called DMAIC, lean or PDCA	Creation of a brand-new, non-existent process. There is no existing process to analyze which requires benchmarking and collection of VOC. Also called DFSS or DMADV

LEAN & Six Sigma - DEFINE

- Project Selection

XY - Prioritization Matrix	ROI Potential	Ease of Implementation	Resource Availability	Cultural Acceptance	Totals
Project Weighted Average	35	20	20	25	100
New Carrier RFQ	5	5	5	5	500
Network Redesign	5	5	3	5	460
Employee Training	5	3	3	5	420
Reslot Warehouse	3	5	3	5	390
DC Relocation	3	1	1	1	170
New ERP System	3	1	1	1	170

Step 1

Step 2

Step 3

Step 4

Y-Axis Rating System Analysis

X-Axis Project & Analysis

Document Basics

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DEFINE Outputs

- Project Selection

- Project Charter

- SIPOC

- Stakeholder Management Plan

- VOC, VOP, CTQ Inputs established

- Process Focus - Process Map

- Team & Change Management Plan / RACI

Project Report-Out

Project Scope
Start Date:
Targeted Completion Date:

Problem Statement

Performance Indicators (CTS/CTQ/CTD)

Financials
Expected savings

Project Team
Champion:
Leader:
Roster:

Project Status				
Phase	Start End	End Date	% Status	Health
Definition				🟢
Measure				
Analyze				
Improve				
Control				
Close-Out				

Healthy 🟢 At Risk 🟡 Late 🔴

1

- SIPOC

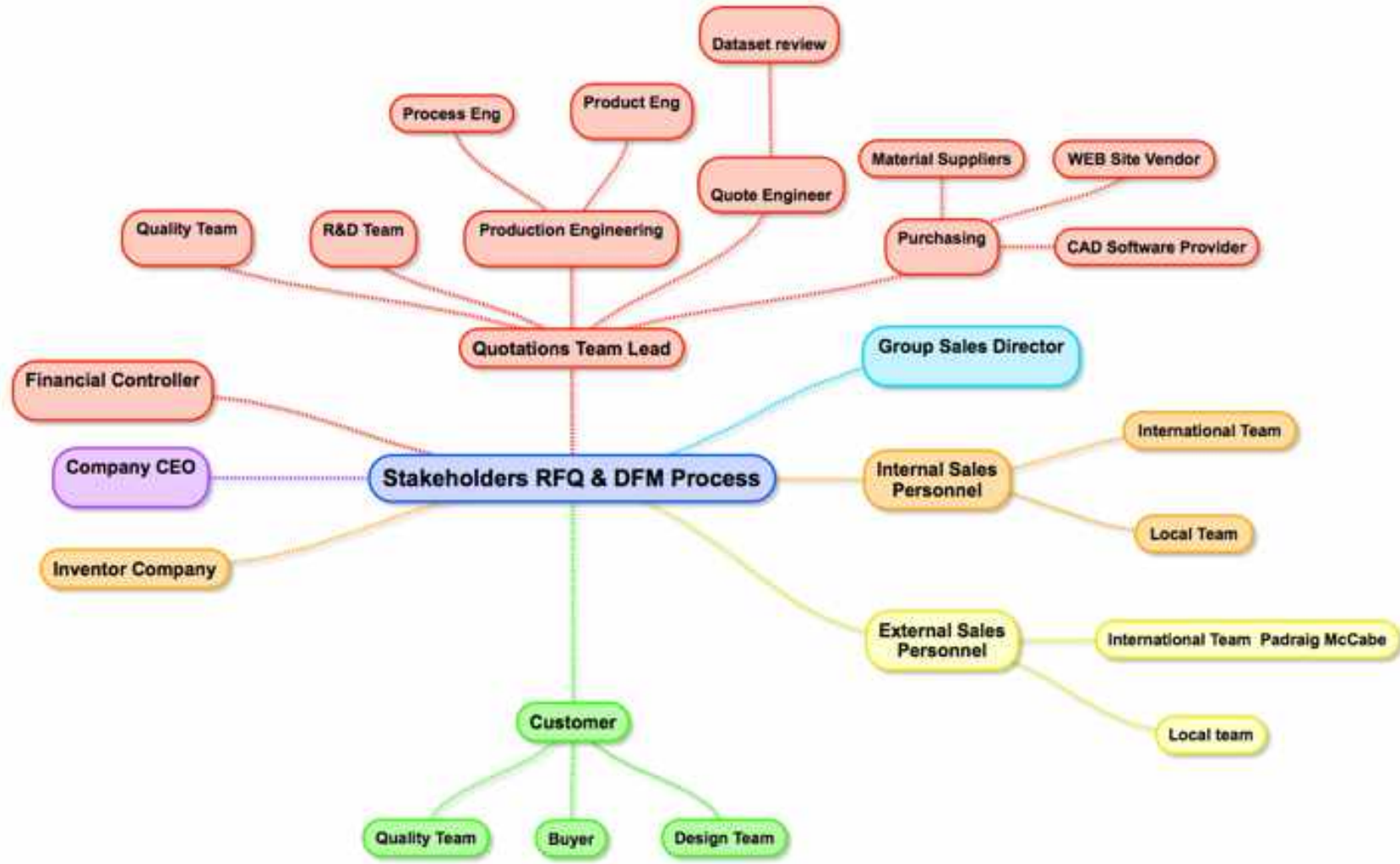| S	I	P	O	C
Supplier	Inputs	Process	Outputs	Customers
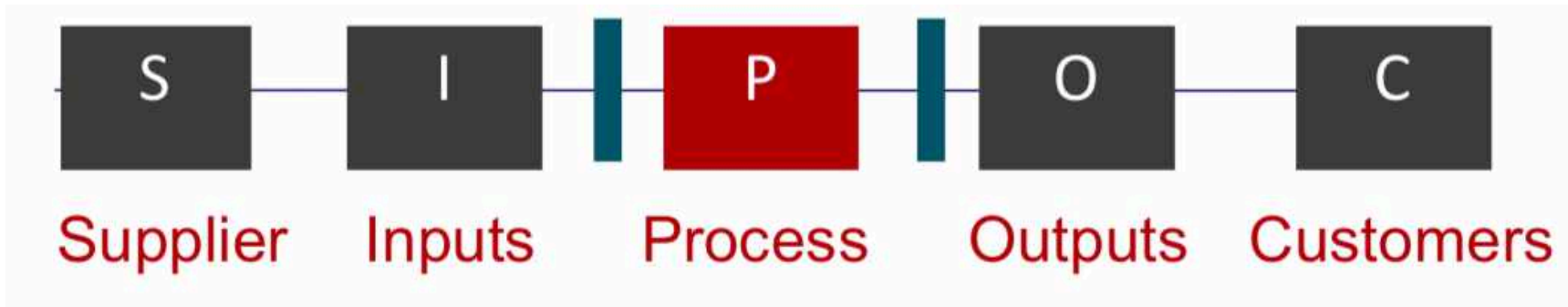
A high level map which helps to visualise the "voice of the customer" and begin to see the relationship between Inputs & Outputs

Critical to:
The Customer
The Market

Critical to:
The Business
The Regulator
The Employees

Process Output Indicators

CTQ's

CTP's

CTP's

Cost/Unit
Productivity
Compliance with Regulations
Changeover Time
Safety
Certification

CTQ's

Price/Unit
Delivery Time
Dimensions
Purity
Reliability
Color
Service Level

Stakeholders RFQ & DFM Process

- Dataset review
- Process Eng
- Product Eng
- Quote Engineer
- Material Suppliers
- WEB Site Vendor
- Quality Team
- R&D Team
- Production Engineering
- Purchasing
- CAD Software Provider
- Quotations Team Lead
- Group Sales Director
- Financial Controller
- Company CEO
- Internal Sales Personnel
  - International Team
  - Local Team
- Inventor Company
- External Sales Personnel
  - International Team Padraig McCabe
  - Local team
- Customer
  - Quality Team
  - Buyer
  - Design Team

| Names	Padraig	Martina	Julie	Jessie	Spiolios	Sinead	Paul	Maria	Jen	Caroline	Nadine	Killian	Jonny
Roles													
Define													
Problem statement	Accountable	Consult	Consult	Consult	Consult	Consult	Consult	Consult	Consult	Consult	Consult	Consult	Consult
Business Case	Accountable												
SIPOC													
Stakeholder Analysis													
Measure													
PCE	Consult	Consult	Consult	Consult	Accountable	Accountable	Accountable	Accountable	Inform	Inform	Inform	Inform	Inform
AR													
LT													
Yield												Accountable	Accountable
Analyse													
Pareto													
5W													
5 Whys													
Improve													
Kaizen													
5S													
SMED													
Control													
Audit													
Standard WI													
Gemba													

Legend:
- Responsible
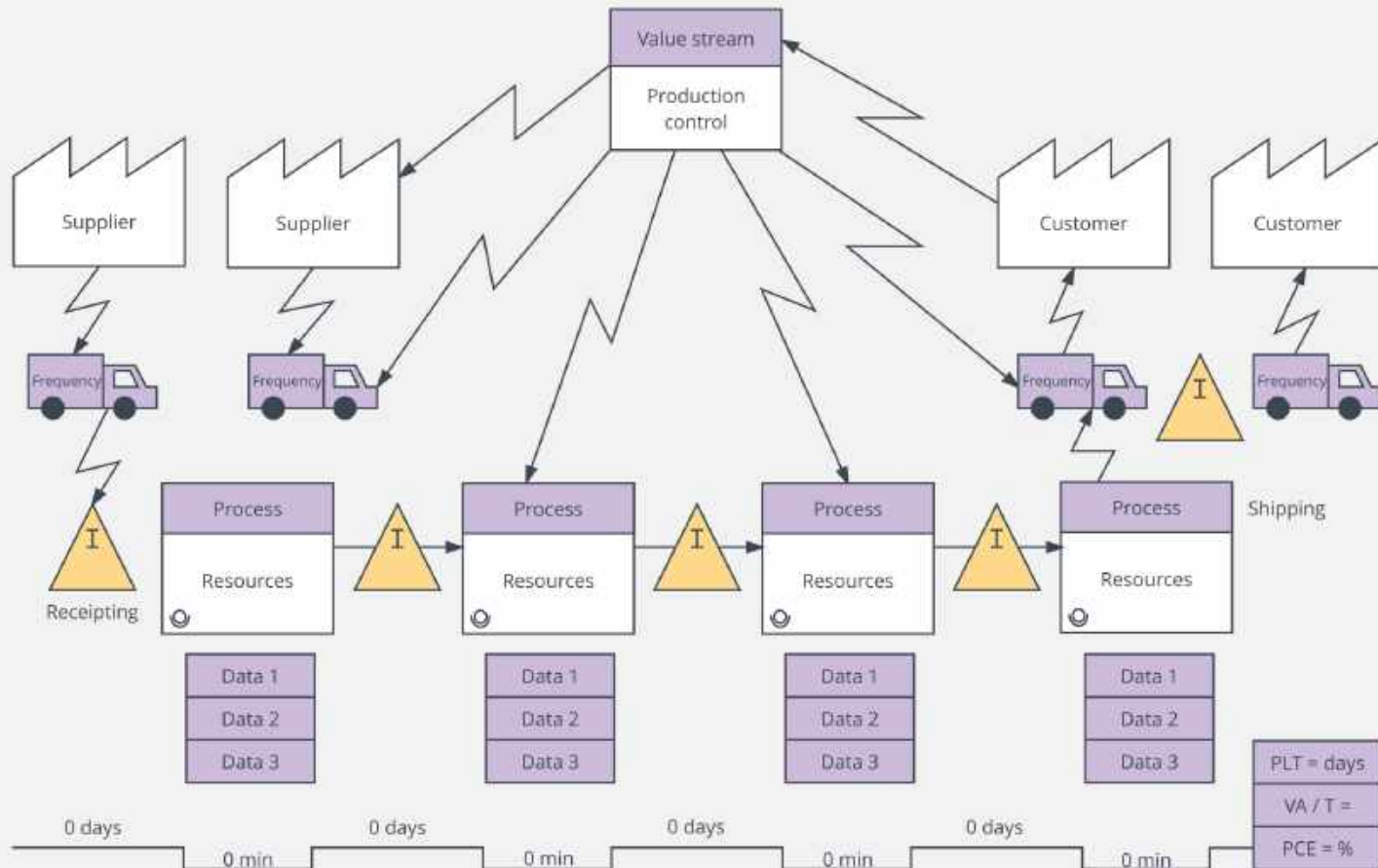- Accountable
- Consult
- Inform

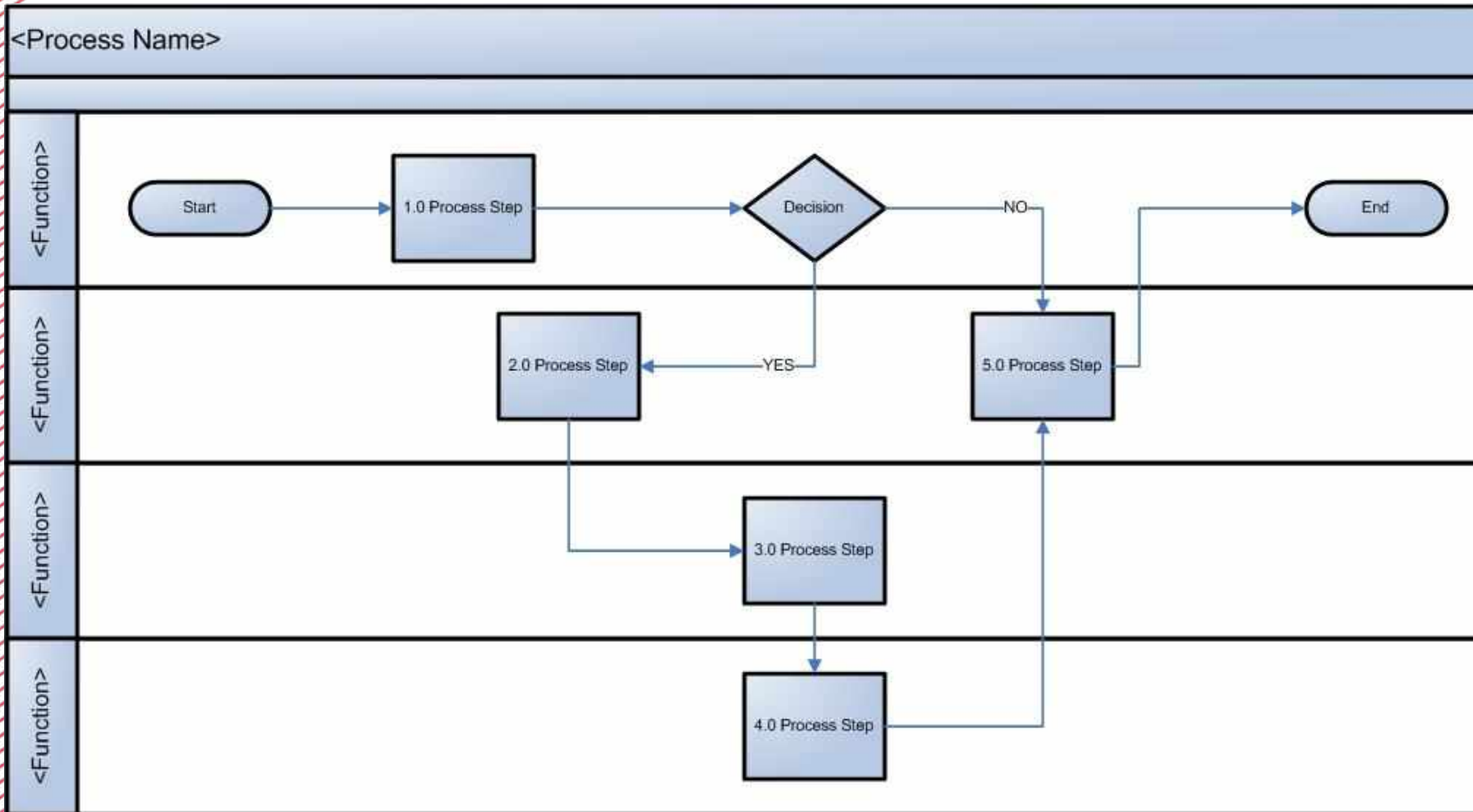What you *THINK* it is..
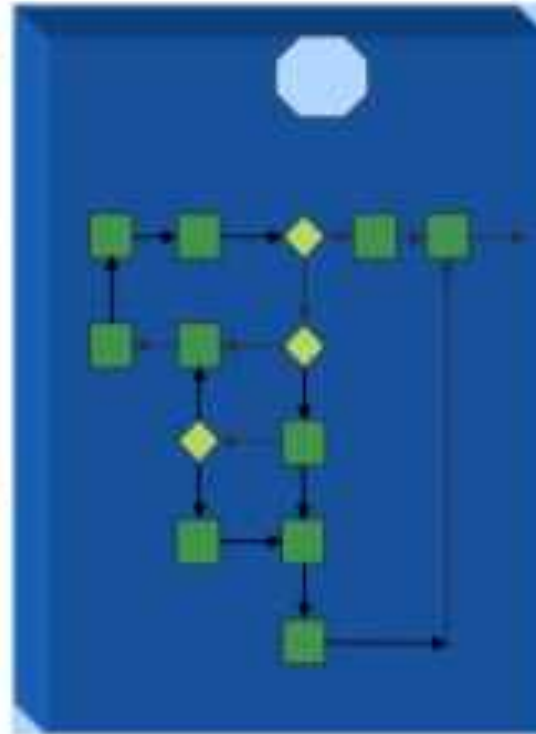
What it ACTUALLY is..
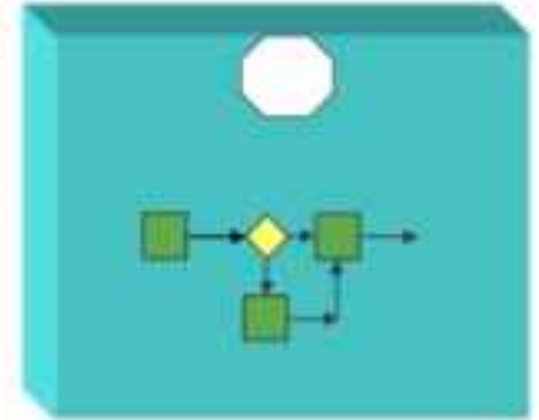
What it SHOULD be..

LEAN & Six Sigma - VSM

Swimlane

Value Stream Mapping – Measurements

- Process Time   PT Timeline

- Waiting Time   WT Timeline

- Leadtime   LT Timeline

- Time Metric   % Activity Ratio (PT / LT)

- Quality Metric   % RTY Rolled Throughput yield

Gate Reviews

GATE REVIEW:

Gate Reviews

Benefits of the Gate Review

- Provides high-impact coaching opportunity
- Helps establish key deliverables
- Relates to Milestones in the project plan
- Prevents project rework
- Prevents false starts
- Generates buy-in
- Provides formal status reporting
- Highlights risks, issues, resource needs
- Shares Best Practices
- Manages EHS impact

DEFINE:

Charter
SIPOC
Stakeholder Mgmt
Team selection
RACI
Current State Map
Voice of Customer

MEASURE:

Data Types
MSA
DPMO
FTY
RTY
OEE
Activity Ratio
PCE
TAKT Time
Process Maps
Cp / Cpk

ANALYSE:

Hypothesis Test
AD Test
ANOVA
MultiVary Study
T-TEST
Pareto
Run Charts
Control Charts
Isikawa
5 W's
5 Whys
FMEA
PICK Chart
DOE
Measures Central T
Mean / Mode /
Median
Range
Quartiles
IQR

IMPROVE:

Kaizen
5-S
SMED
KanBan
Poka Yoke
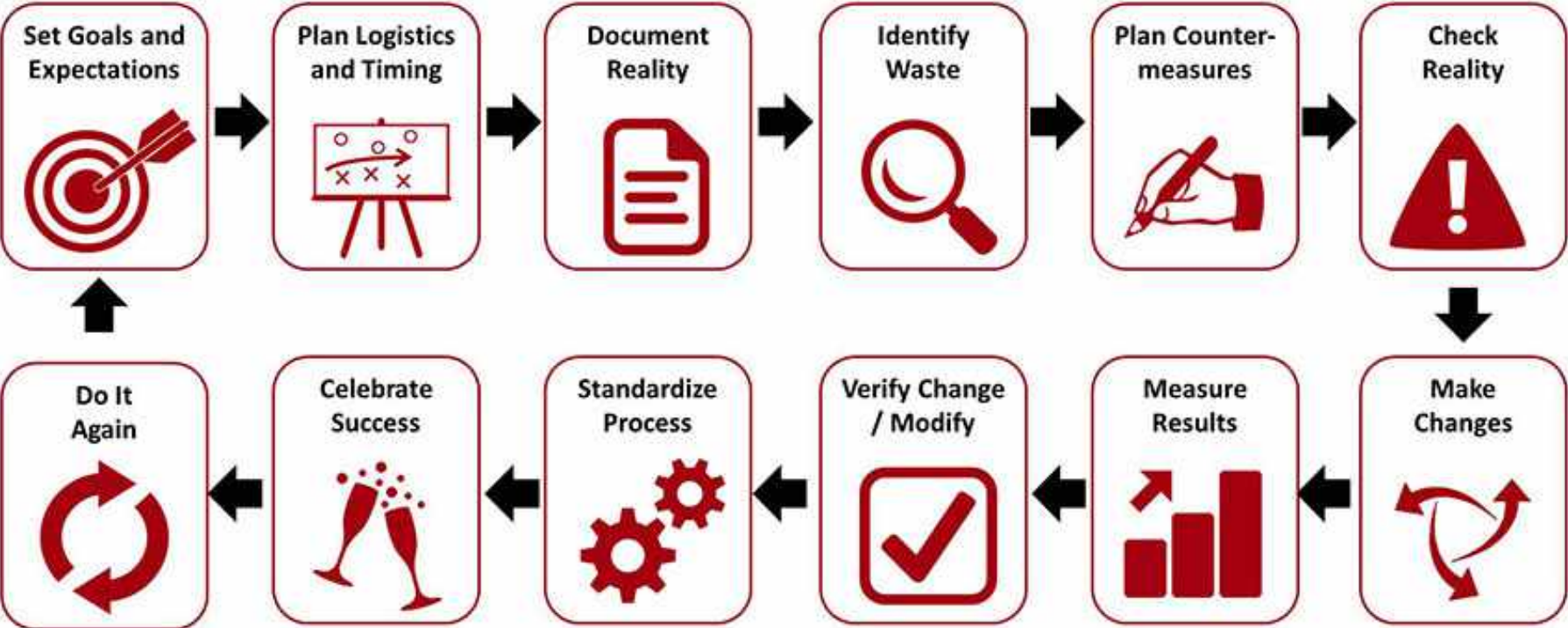Visual management
ANDON
GEMBA
TPM

CONTROLS:

Standard Work
Future State Map
Audits
KPI's
Control Charts
Quality Plan
Response Plan
Reward & Recognize

KanBan

Kaizen

KAIZEN Event

A3 Basics

A3 & PDCA Cycle

Background & Support Data
(PLAN)

Implement the Countermeasures
(DO)

Describe the Current state
What are we trying to solve.
(PLAN)

Set Goals and Targets.
Define what success looks like
(PLAN)

Follow UP (Check)

Perform Root Cause Analysis
(PLAN)

Follow UP (Act)

Design Counter Measures
(PLAN)

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Project Leadtime

Plan

Do

Check

Act

Project Leadtime